



THE AUSTRALIAN NATIONAL UNIVERSITY

*Assessing the Vulnerability and Adaptive Capacity of
Australian Settlements to Impacts of Climate Change and
Variability*

**IDRC International Disaster and Risk Conference: from
thoughts to action**

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IA is a collaborative process and this study wouldn't have happened without:

- IACCIUS partner jurisdictions – States & Territories of Australia: ACT Gov, Queanbeyan City Council, Cooma-Monaro Shire Council, City of Greater Bendigo, NT Gov.
- Funding agency: The Federal Australian Government Department of Climate Change (DCC)
- IACCIUS team from Fenner School (Steve Dovers, Geraldine Li, Paula Sutton, Joseph Guillaume, Mike Hutchinson, Katrina Proust, Rob Dyball, Pat Troy, Leo Carroll, Hons students: Alex Campbell-Wilson, Carina Wyborne)

- Climate change, in both mitigation and adaptation, is a systemic problem, because:
 - Causes are deeply embedded in patterns of production and consumption, settlement and governance
 - Impacts are widely distributed across sectors and places
 - Strong connectivity both across and within categories of causes and impacts

Why do IA?



Darwin: 'Tropics, Power lines, Lifestyle' - Integration.
Photo by G. Li.

- Therefore, assessment approaches need to:
 - Integrate environmental, social, economic factors
 - Integrate research, policy and stakeholder communities

The Integrated Assessment Society:

- Integration of knowledge from different disciplines with the goal to contribute to understanding and solving complex societal problems, that arise from the interaction between humans and the environment, and to contribute in this way to establishing the foundation for sustainable development. Modelling and participatory processes should include stakeholder groups and the public at large.

This IA project: 'IACCIUS'

- One project funded under DCC Settlements Sub-program: (other projects are in Sydney, Tasmania, Melbourne, Gold Coast) about to conclude in June 2008.
- Goal of DCC Sub-program is to increase focus on 'urban' impacts rather than traditionally on NRM sectors
- IACCIUS focus was on
 - small-medium sized urban settlements
 - energy, water, urban vegetation, planning, extreme events and other issues of relevance to partners.

IACCIUS Project aims:

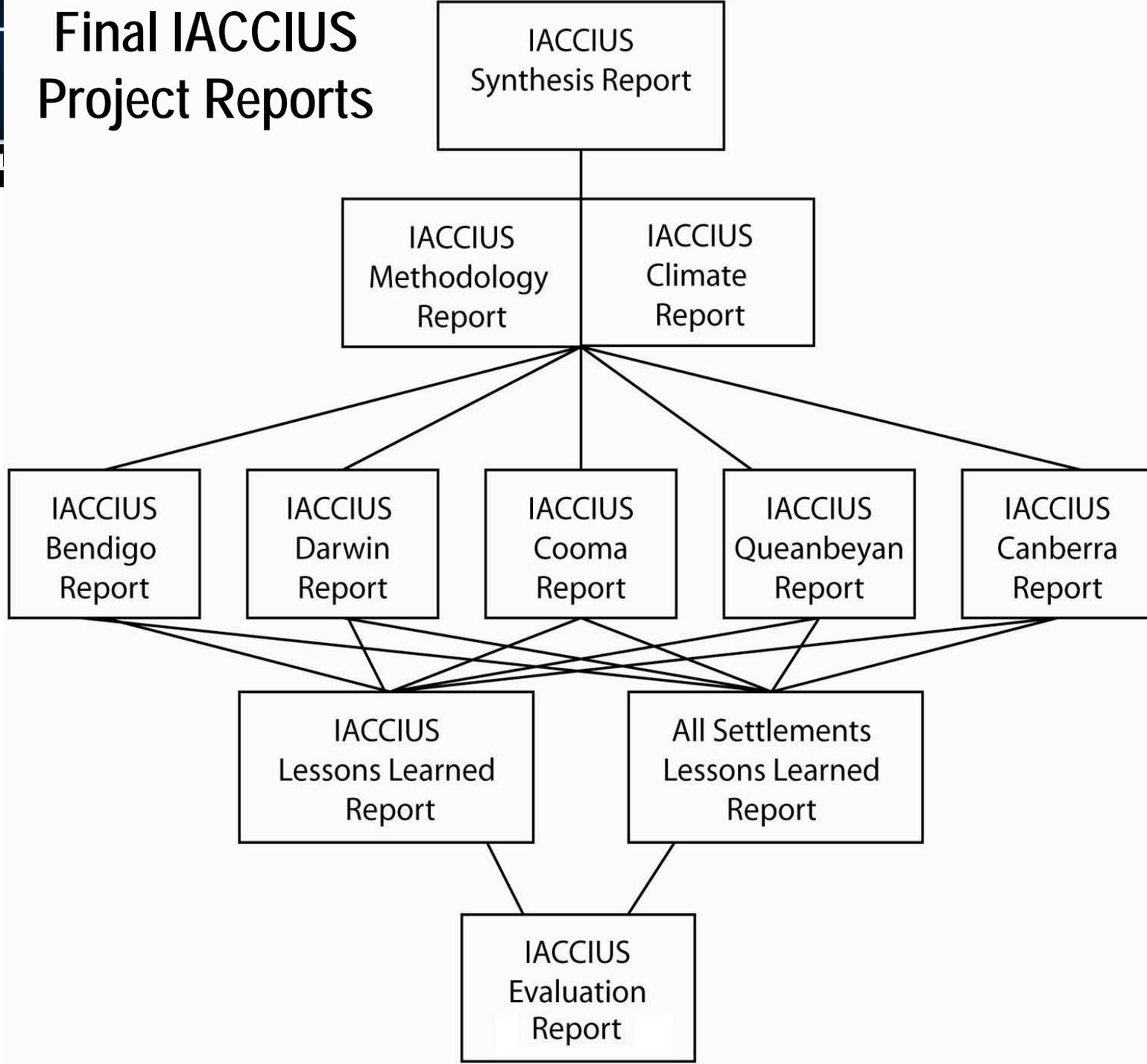


1. Insights into climate change impacts, vulnerabilities and adaptive capacity of case study settlements.
2. Methodological development for integrated assessment of climate change impacts on urban settlements.

Canberra Hailstorm: 27 Feb 2007.
Photo by R. Baker.



Final IACCIUS Project Reports



- The IACCIUS methodology:
 - Is an intent and a process, with emerging underlying principles and processes.
 - Is undertaken within a range of frameworks.
 - Is undertaken in a wide range of places, scales and problem contexts.
 - Utilises a range of methods, according to need.
 - Involves a variable range of groups and skills.
 - Actively carries out reflexive and iterative research practice
 - Takes a complex systems view of settlements, which we've sketched to look like...

LOCAL URBAN SYSTEM

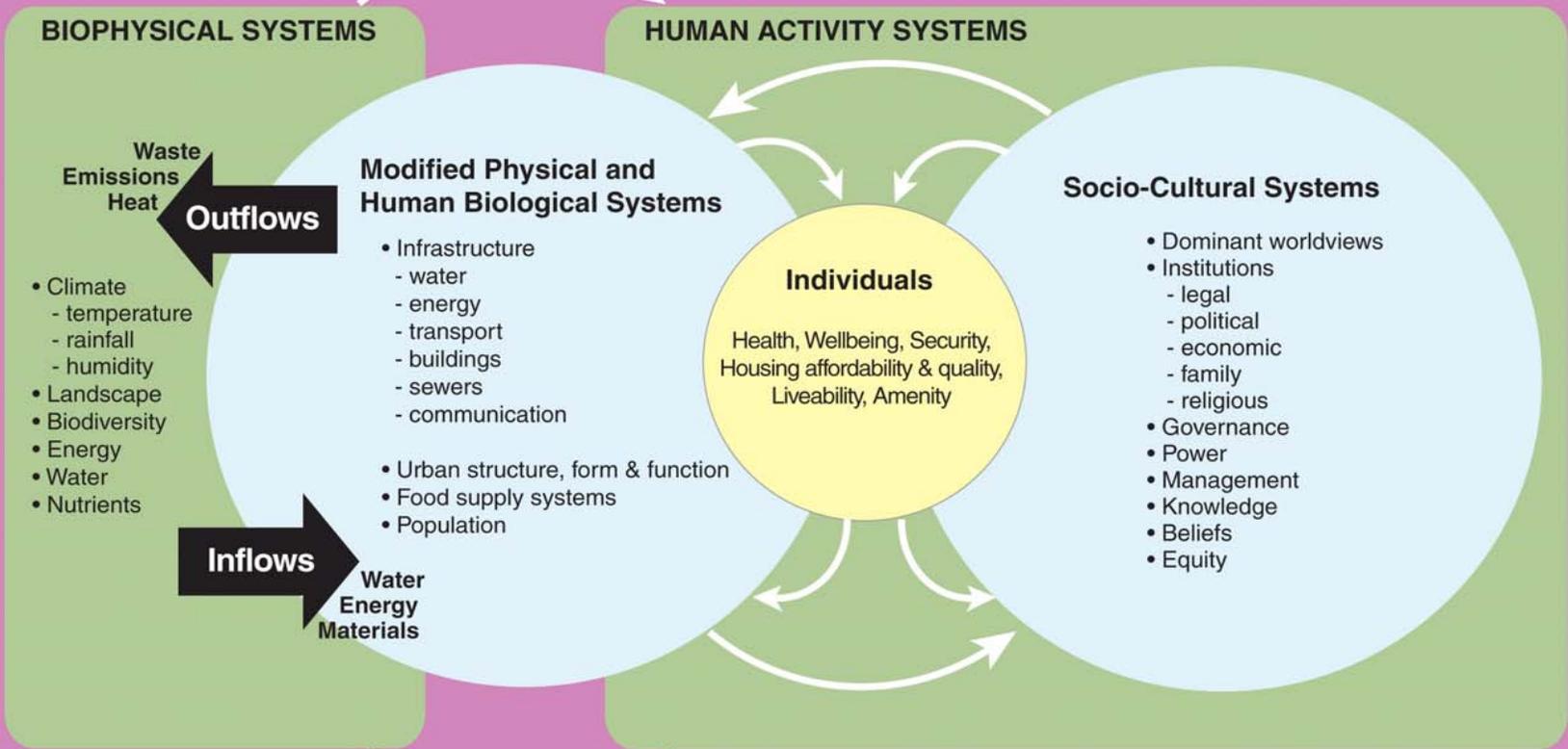
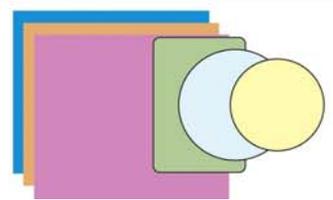


Figure 3 Generic Urban System
 (Source: adapted from Boyden et al., 1981b, pp. 90-92, Figures 4.1, 4.2 and 4.3; and Millennium Ecosystem Assessment, 2003, p.37, Box 1.4)



Systems and Subsystems



Interactions and Feedbacks

Utilises multiple and different forms of information from across many disciplines:

- Social learning & stakeholder participation
- Systems thinking
- Urban studies
- Policy studies
- Climate science
- Risk management
- Vulnerability approaches (exposure, sensitivity, adaptive capacity)
- Uncertainty understandings

Integrating these methodologies became called the ISRaVA process



UFO? No, Darwin Water Tower.
Photo by P. Sutton.

The ISRaVA (integrative systems risk and vulnerability assessment) Process:

- Ten broad steps conducted iteratively (which aligns with traditional risk management approach) and includes an ISRaVA workshop and subsequent detailed subsystems analyses
- With understanding of an urban settlement viewed as a system
- These ten steps can be summarised as:

ISRaVA Process: Summary

Risk Management Step	ISRaVA process
Establishing the context	<ol style="list-style-type: none"> 1. Whole-of-system engagement (incl. PPP) 2. Local climate change and variability analysis
Identifying & analyzing what's at risk & the vulnerabilities	<ol style="list-style-type: none"> 3. Whole-of-urban system risk analysis (workshop) 4. Communication strategy 5. Policy history and ongoing policy processes 6. Assess vulnerability for the priority subsystems 7. Adaptation analysis
Evaluating & reviewing the processes	<ol style="list-style-type: none"> 8. Identify data/knowledge gaps 9. Disseminate/communicate findings
Treating the risks & vulnerabilities	<ol style="list-style-type: none"> 10. Implement adaptation strategies

- IACCIUS project used a multi-method approach and remains open to the most useful methods for data collection and analysis
- Method selected is dependent on the data source and the available skills and resources of the assessment team
- Most common methods used in IACCIUS:
 - secondary data: climate data analysis, risk and vulnerability assessment, systems analysis, spatial analysis, policy analysis, time series analysis
 - primary data: systems analysis and participatory methods

Case Study Focus

- All towns: Settlement history and socio-demographic profiles; local climate variability and change analyses
- Cooma: Systems analysis; detailed analysis of tourism-economy subsystem
- Darwin: ISRaVA workshop; spatial differential vulnerability assessment, incl. water and energy consumption
- Bendigo: ISRaVA workshop; detailed analysis of sport & recreation subsystem
- Qbn: ISRaVA workshop; detailed analysis of storm water and impervious surface subsystem
- Canberra: ISRaVA workshop

- Scoping and problem definition
- Stakeholder and urban system characteristics
- Flexibility and uncertainty
- Relevance to local decision making
- Adaptation, mitigation and adaptive capacity
- Participation and communication
- Workshop processes
- Data acquisition

Summary of Private and Public Organisations

Category	Private (PR), Public (PU), Community (CO)
Executive and legislature; government agencies (national, state-provincial)	PU
Statutory authorities and other semi-autonomous public agencies	PU PU-PR
Local government	PU
Public trading corporations	MX: PU, PR
Private firms	PR
Epistemic communities (organized around expertise)	PU-PR
NGOs, informal institutions, community-based organisations	CO-PU

Climate Variability and Change: Example from ACT region

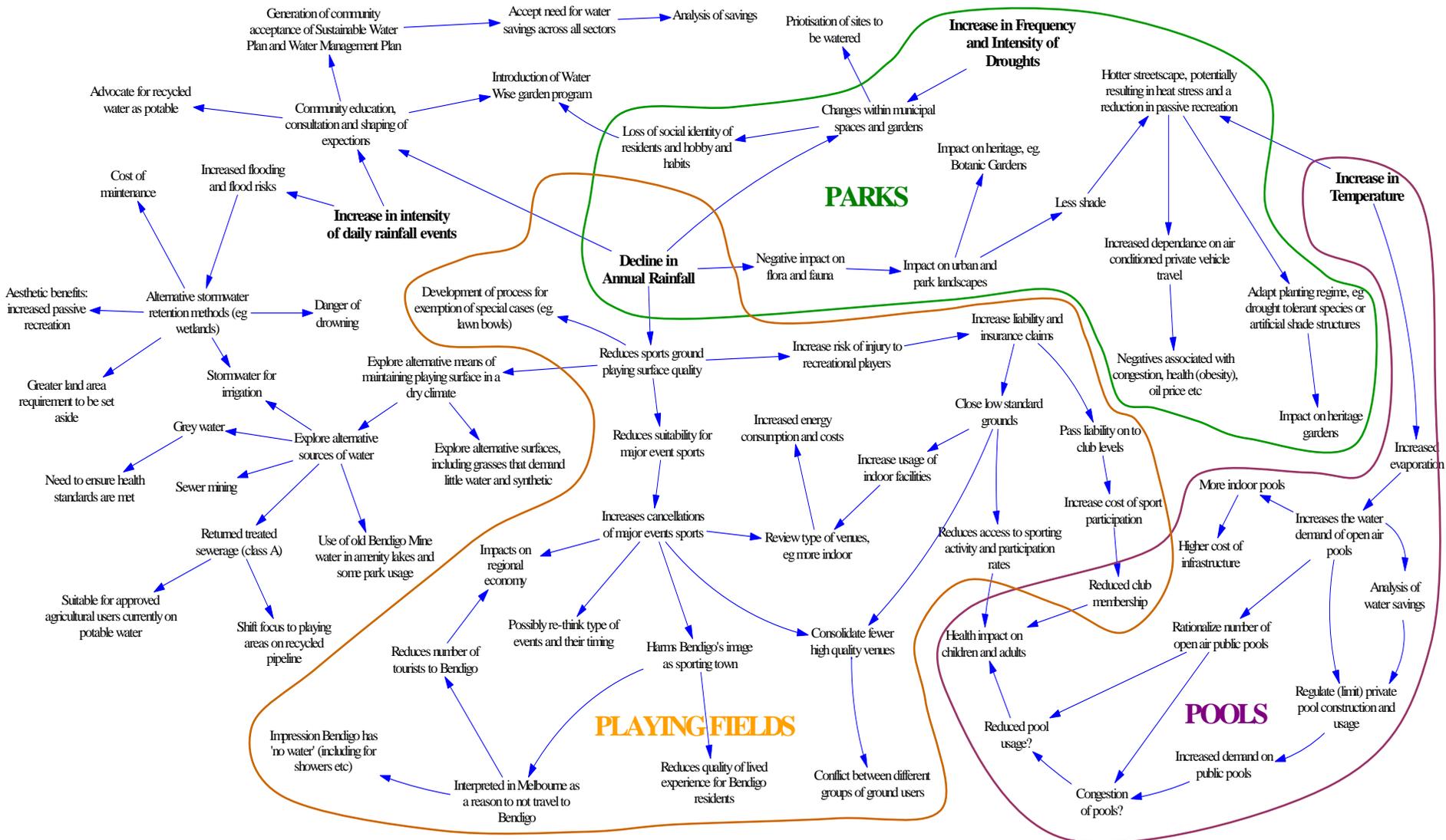
Summary projected trends for the ACT region

Climate variable	Projected trend
Daily maximum temperature	Increase – more very hot days, with daytime temperatures in summer possibly increasing more than the daytime temperatures in winter.
Daily minimum temperature	Increase – more warm nights, with night-time temperatures in winter possibly increasing more than night-time temperatures in summer.
Heatwaves	Increase.
Frost days	Decrease.
Summer humidity	Decrease - relative humidity and dew point to decrease in summer with decreasing rainfall.
Winter humidity	Possible increase - relative humidity and dew point may increase if rainfall continues to increase in winter.
Potential evaporation	Increase - particularly in summer with a decrease in summer rainfall.
Storm frequency and intensity	Projections uncertain. Summer rainfall may decrease. Winter rainfall may increase and with increased intensity.
Drought frequency and intensity	Likely to increase with decreasing rainfall, increasing potential evaporation and increasing maximum temperature.
Bushfire frequency and intensity	Likely to increase with decreasing summer rainfall, decreasing humidity and increasing maximum temperature.

- **ISRaVA workshops conducted with stakeholders involved:**
 - Undertaking a preliminary assessment of the climate change impacts on the urban settlements using systems thinking and integration tools
- **The workshop outcomes include:**
 - The development of a systems diagram that incorporates key climate change variables relevant to the urban settlement and risks, vulnerabilities and impacts identified by workshop participants
 - From this a small number of priority issues or 'subsystems' identified by each jurisdiction in the workshop are agreed upon for investigation by the IACCIUS team.
 - Not all priority issues/subsystems were investigated by the IACCIUS team - the IA process intends to integrate across settlements, impacts and sectors.

1. Impact of low rainfall on the urban landscape:
 - the flow-on implications for liveability, recreation and sporting events. We have called the IACCIUS component of the study an analysis of "*Pools, Parks and Playing fields*"
 - impacts on the community's health and wellbeing
2. Increased demands on local government
3. Impact on the elderly and other vulnerable groups

Subsystem Influence Diagram: Sport and Recreation in Bendigo



Further Subsystems: Bendigo's 'Pools', 'Parks' and 'Playing Fields'

1. Differential vulnerability

- an analysis into which parts of the Darwin population are most vulnerable to the impacts of climate change. E.g. geographical (storm surge zone), built environment (cyclone wind intensity), socio-economic, seasonal migration and demographic flows

2. Water and energy consumption:

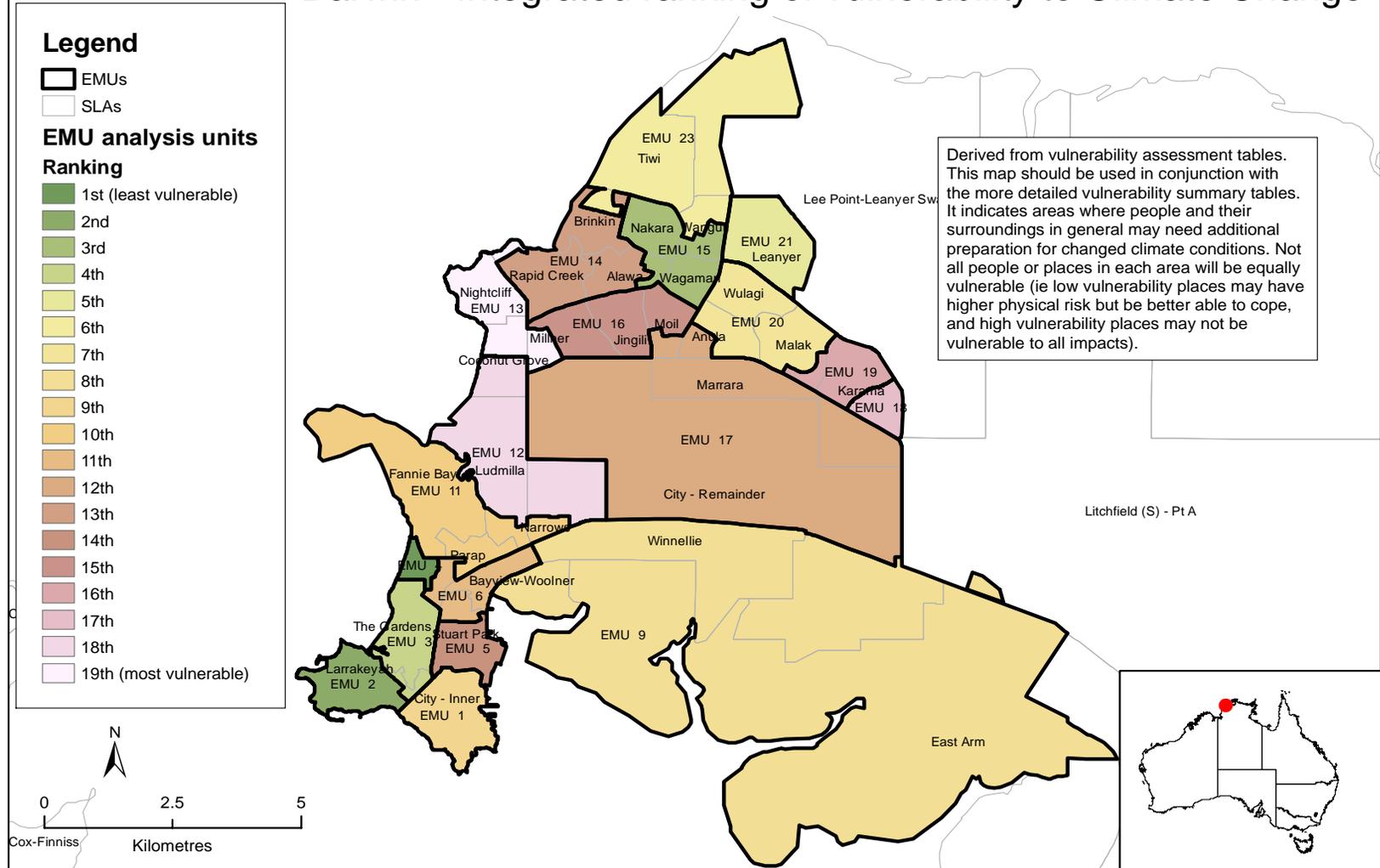
- an analysis of water and energy use patterns and correlations with temperature and humidity

3. Impacts on liveability and visit-ability:

- an analysis of the impacts of heat and cyclone activity on lifestyle and tourism in Darwin

Differential Vulnerability Assessment: Darwin

Darwin - Integrated ranking of vulnerability to Climate Change



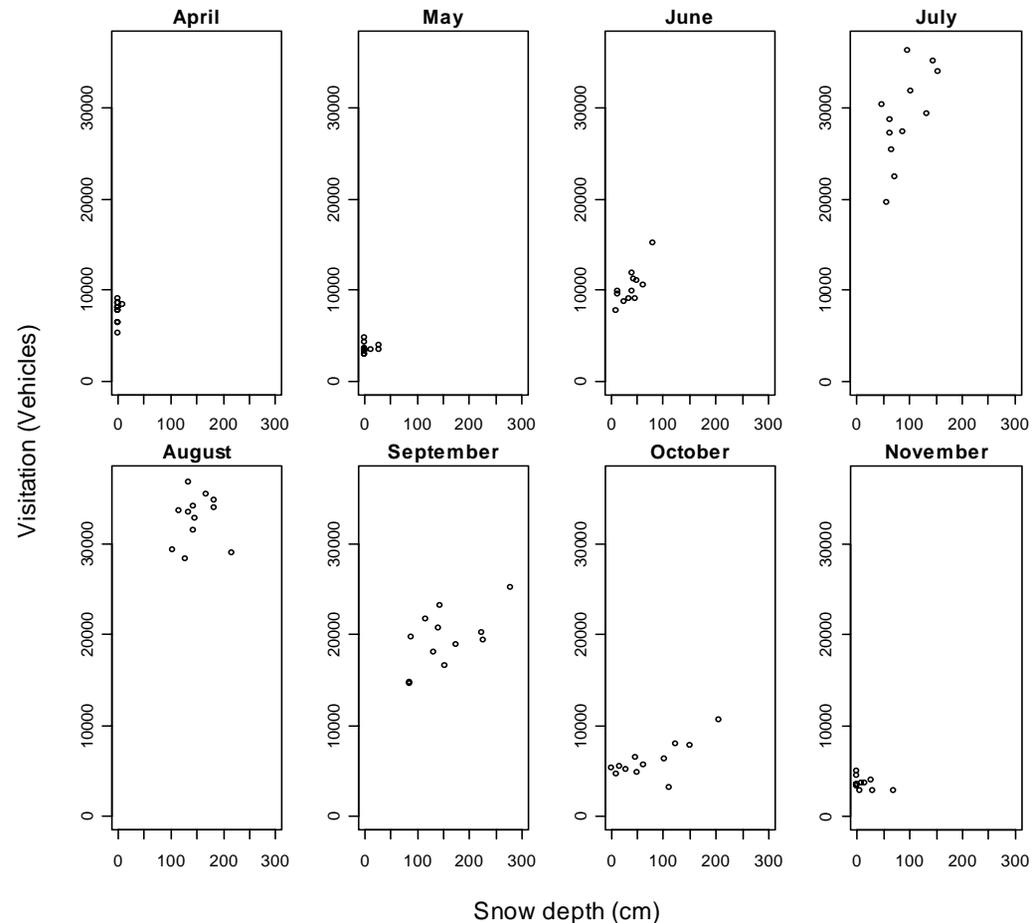
Cooma : Priority Subsystems

1. Economic impact from a reduction in Snowy Mountains tourism
 - an analysis into the vulnerability of the Cooma tourism sector to changes in climate
2. Impacts of climate change on water planning, including demography

Cooma: Climate-Tourism-Economy Systems Workshop.
Photo by P. Sutton.

Correlation between average snow depth and visitation by month

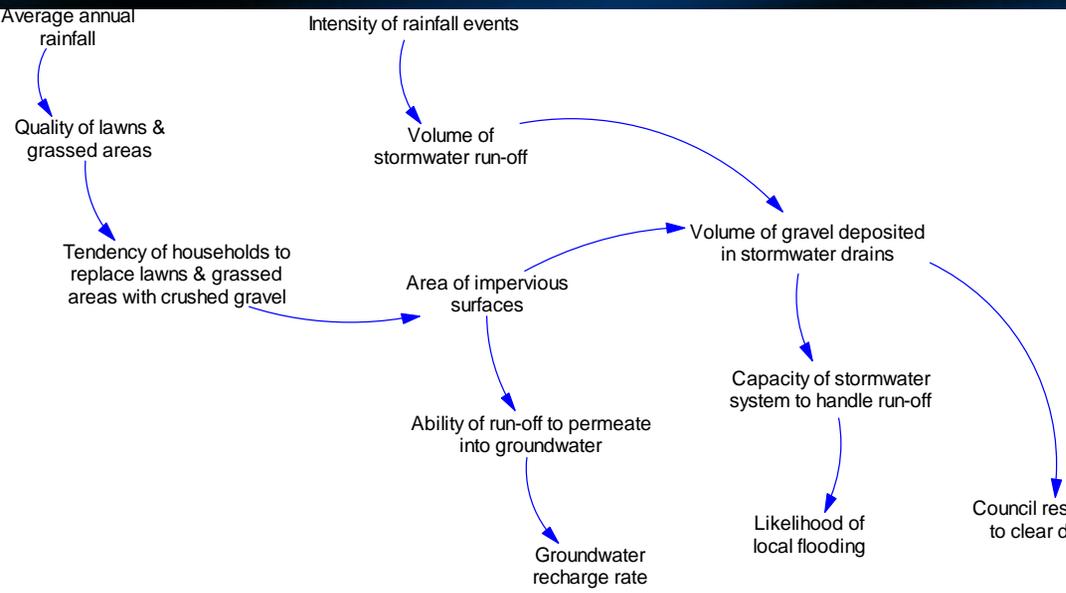
- Visitation rates in June, July, Sept. and Oct. show discernable correlation with snow depth (*snow conditions influence visitation more*)
- Less correlation in Aug. and Sept. (*snow conditions influence visitation less, peak season, school holidays*)



Sources: Snow: Snowy Hydro Limited, 2007. Spencer's creek snowcourse. Passes issued: National Parks & Wildlife Service, 2007, at Alpine Way and Kosciuszko Road park entry gates

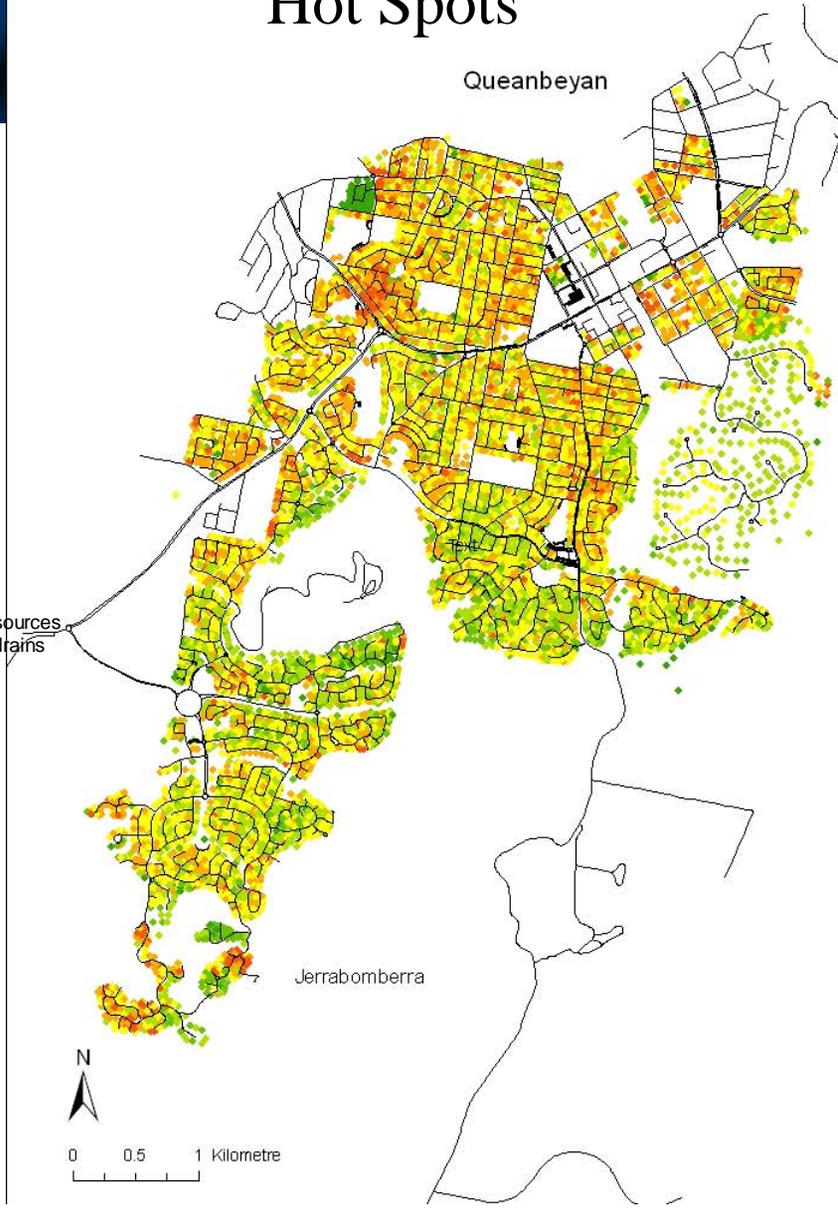
1. Energy and water supply and consumption
 - investigate the impacts of climate change on energy and water consumption, with consideration of governance and population growth targets and water and emissions reduction and sustainability targets
2. Parks, gardens and landscapes
 - investigate the biophysical and social impacts of climate change on urban parks, gardens and landscapes
3. Emergency management
 - investigate the impacts of climate change on emergency management arrangements

Queanbeyan: Mapping Impervious Surfaces



- Aerial photograph series (taken in 2004, resolution of 75cm/pixel)
- Land-use information from QCC
- 2006 Population and Housing Census data (Social Atlas, ABS, 2008) - Pop. Density and Socio-economic status
- Qualitative data (interview and meetings)
- Observations on building type, size, age, landscaping and other characteristics

Hot Spots



- Integrated approaches are necessary to deal with complex whole-of-society problems like climate change impacts on urban settlements
- IACCIUS project has provided a methodology for doing this for Australian urban settlements
- Ideally for state and local governments this can be done through a 3-step process:
 1. Whole of system analysis;
 2. Sub-system investigations; and
 3. Re-integration of sub-system analyses.
- Process should eventually be mainstreamed into organisations ongoing risk management, community, environment, planning and other processes
- Watch the DCC & Fenner/IACCIUS website for project reports and academic literature

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